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B41J 2/175

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(54) An ink supply port arrangement for a multi-colour ink cartridge

(57) An ink cartridge 1 has a plurality of ink chambers 2a-2f wherein ink supply ports 4a-4f associated with the chambers are arranged in two linear arrays, such that the size of the cartridge can be reduced, and easy loading of the cartridge is ensured. The ink supply ports may be arranged in a zig-zag, offset manner to allow for a further reduction in the size of the chambers and cartridge. At least one reinforcing rib (15,Fig.5(a)) is provided on the outside of the cartridge, to ensure the strength and rigidity of the cartridge. Circuitous grooves (35a-35f,Fig.8(b)) are formed in the surface of a cover member (30) so that the grooves (35a-35c) communicating with ink chambers (12a-12c, Fig.8(a)) having smaller volumes are longer than grooves (35d-35f) communicating with chambers (12d-12f) having larger volumes, thus insuring uniform viscosities of all of the inks.

FIG.1 (a)

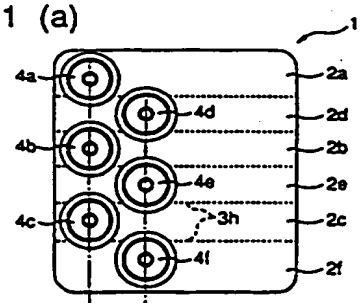

FIG.1 (b)

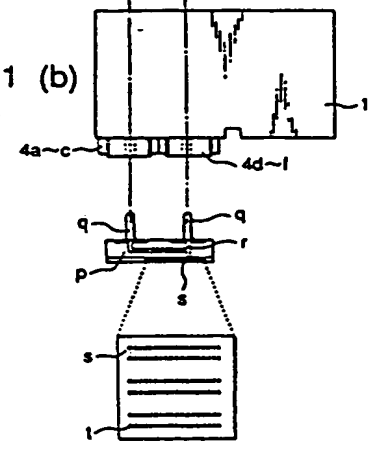

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FIG.1 (a)

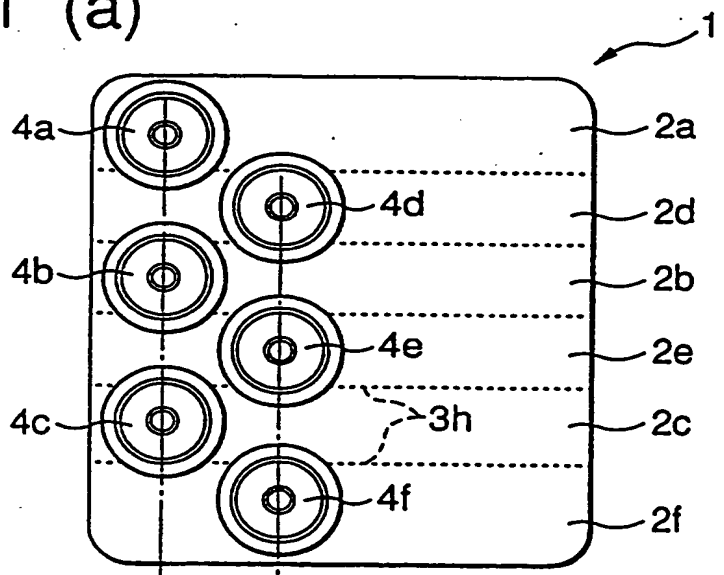


FIG.1 (b)

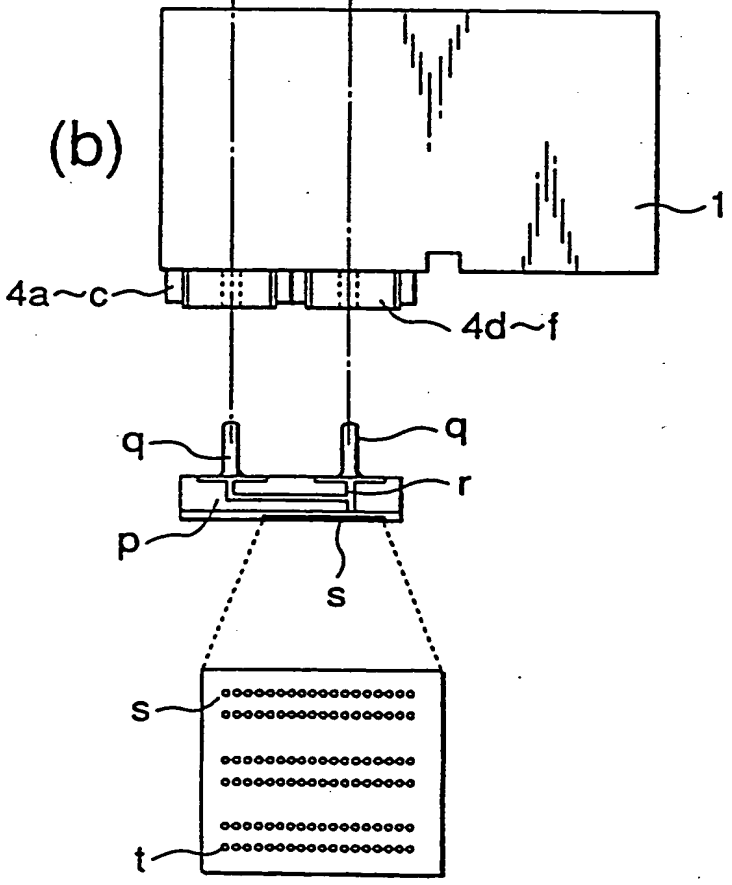


FIG.2(a)

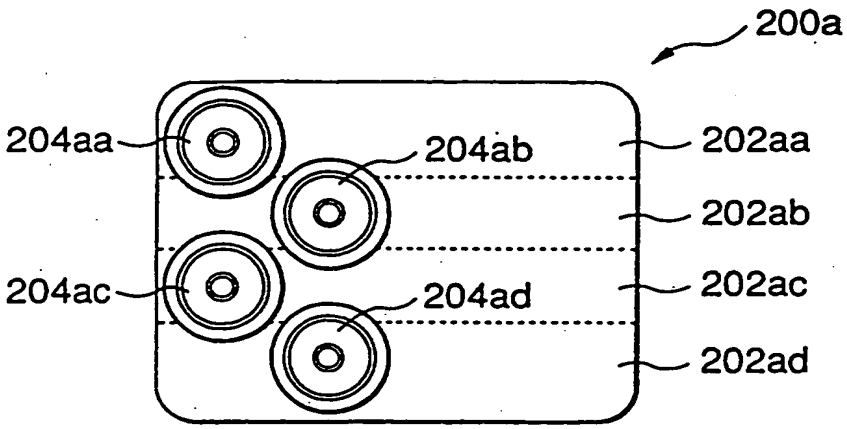

200a
204aa
204ab
202aa
202ab
204ac
204ad
202ac
202ad

FIG.2(b)

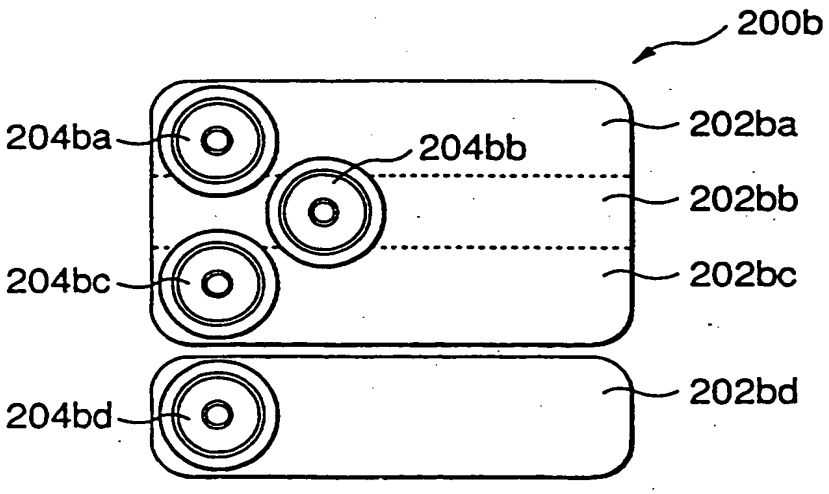
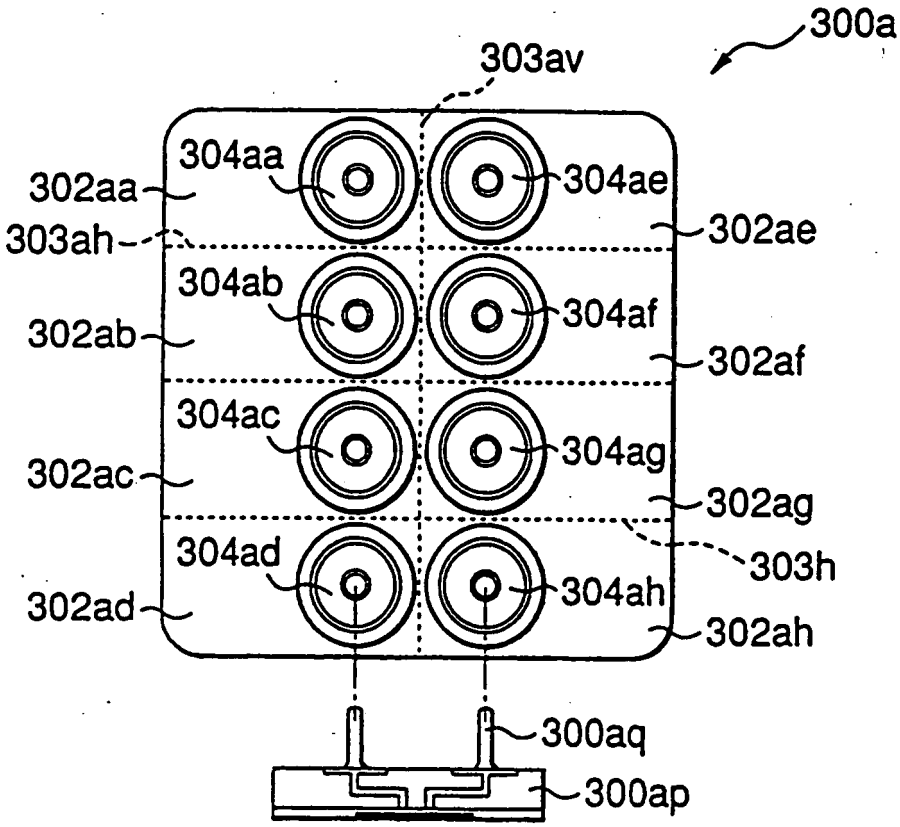

200b
204ba
204bb
202ba
202bb
204bc
202bc
204bd
202bd

FIG.3(a)


300a
303av
304aa
304ae
302aa
303ah
302ae
304ab
304af
302ab
302af
304ac
304ag
302ac
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304ad
304ah
302ad
302ah
300aq
300ap

FIG.3(b)

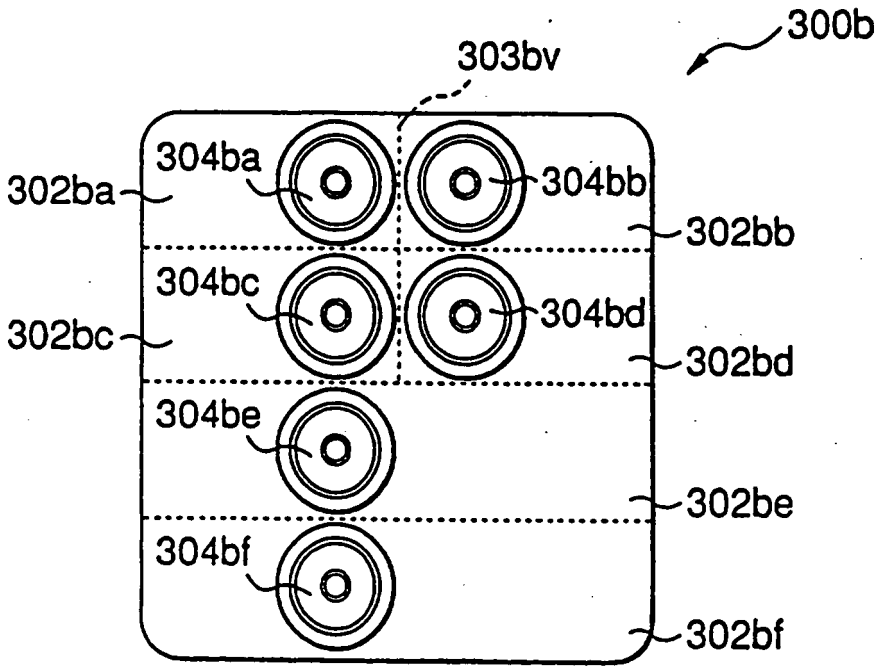

300b
303bv
304ba
304bb
302ba
302bb
304bc
304bd
302bc
302bd
304be
302be
304bf
302bf

FIG.4(a)

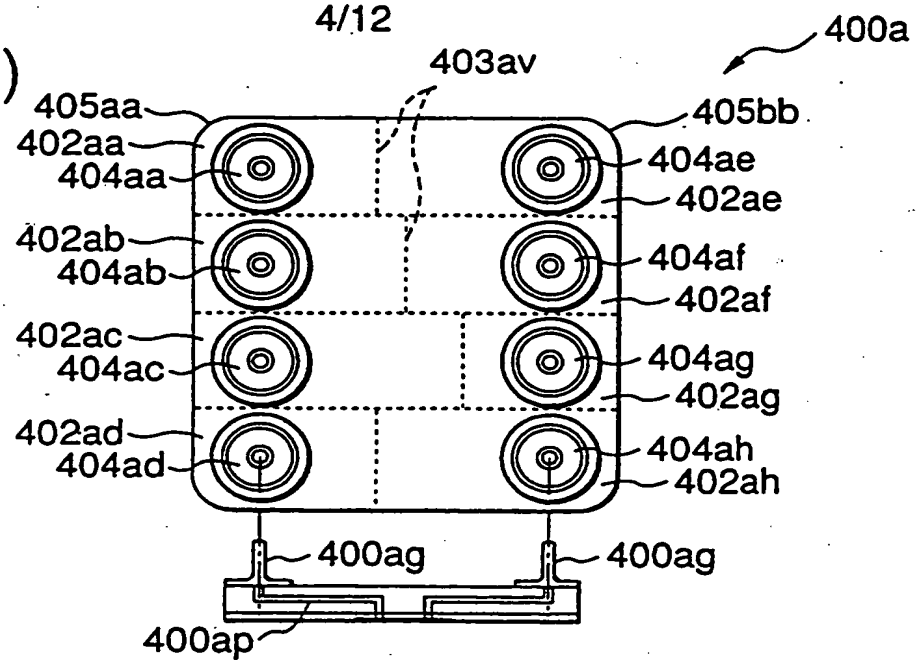


FIG.4(b)

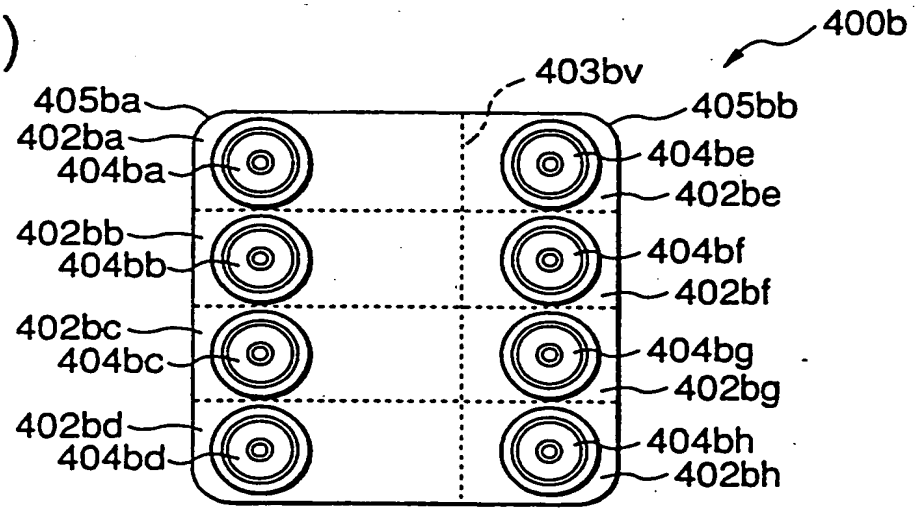


FIG.4(c)

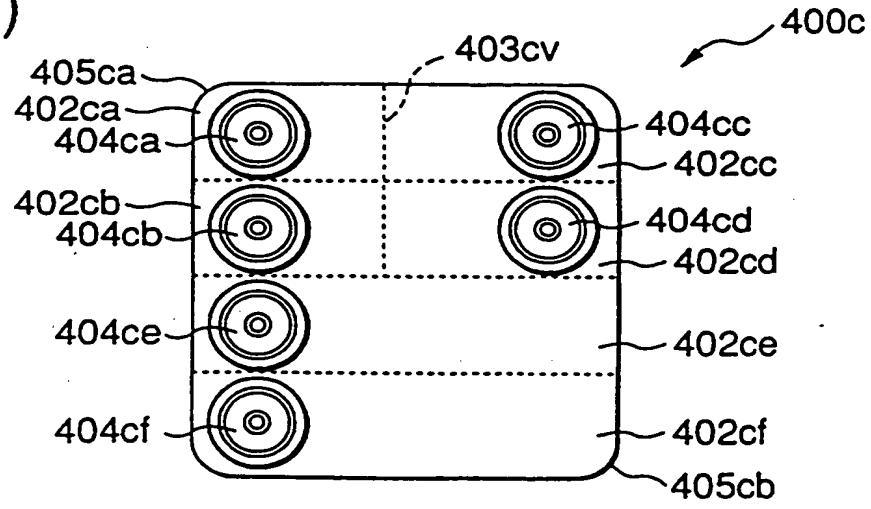


FIG.5(a)

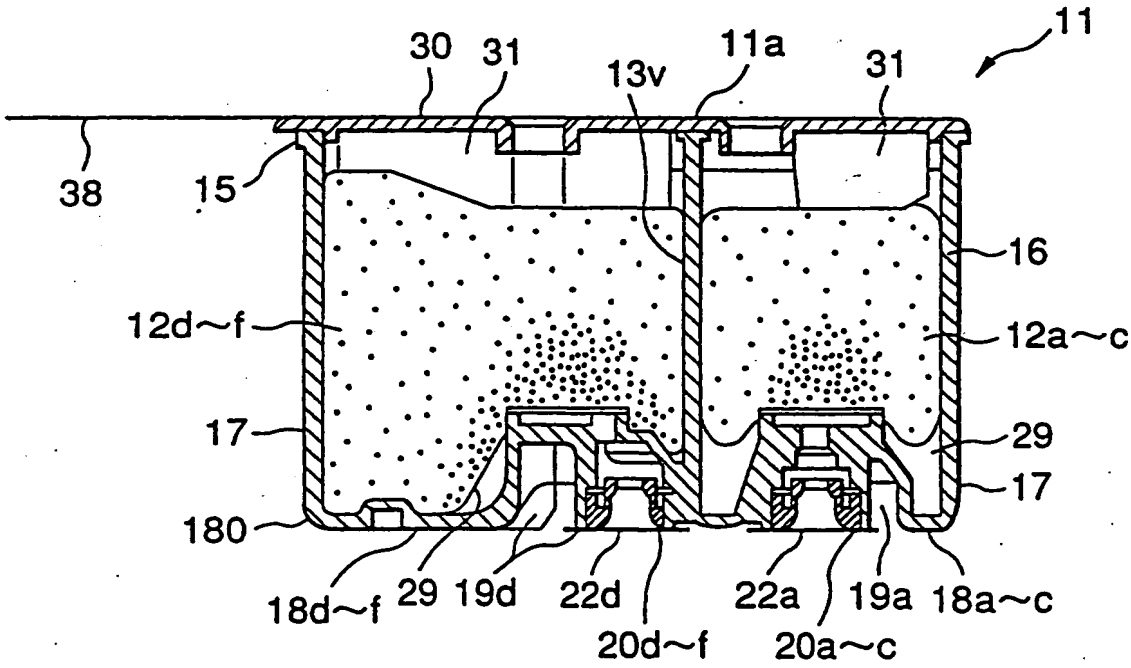

11
30
31
13v
11a
31
38
15
16
12d~f
12a~c
17
29
17
180
18d~f
29
19d
22d
22a
19a
18a~c
20d~f
20a~c

FIG.5(b)

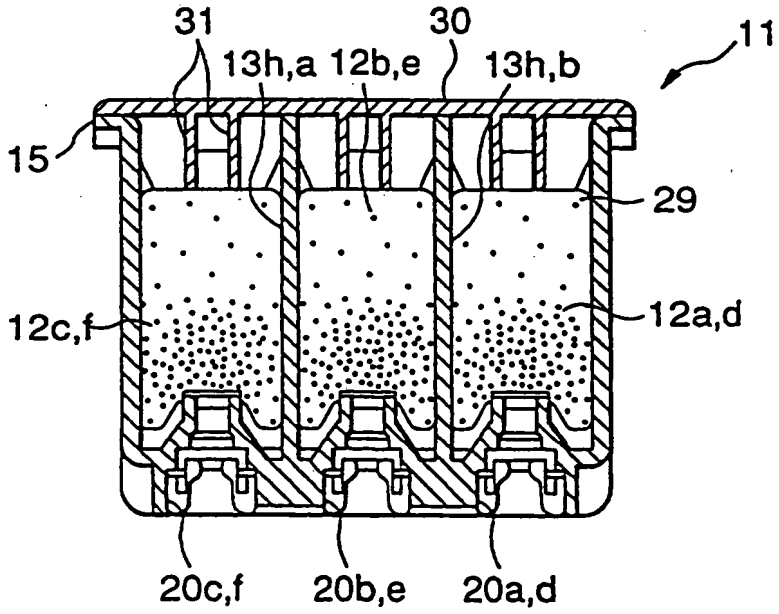

31
30
11
13h,a
12b,e
13h,b
15
29
12c,f
12a,d
20c,f
20b,e
20a,d

FIG.6(a)

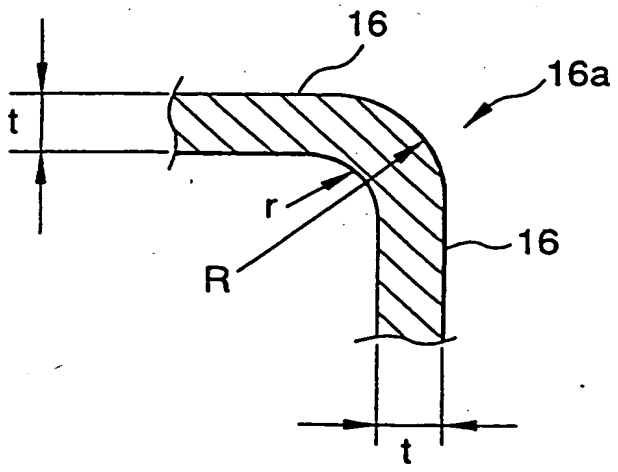


FIG.6(b)

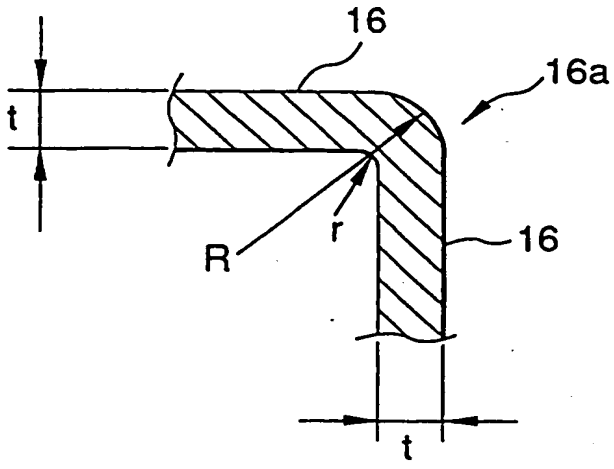


FIG.7(a)

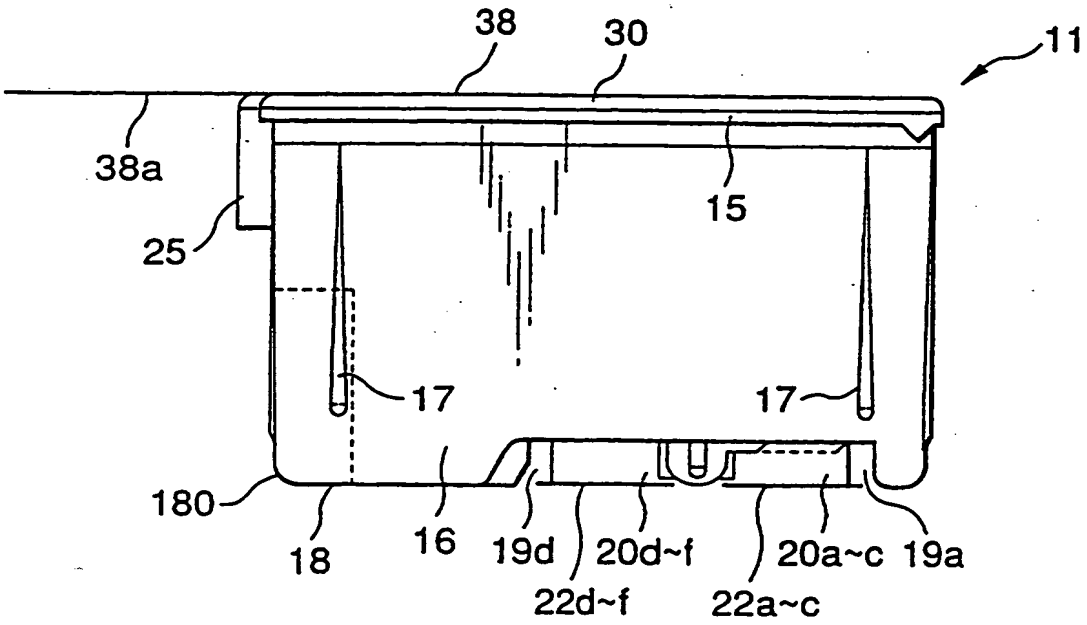

38
30
11
38a
25
15
17
17
180
18
16
19d
20d~f
20a~c
19a
22d~f
22a~c

FIG.7(b)

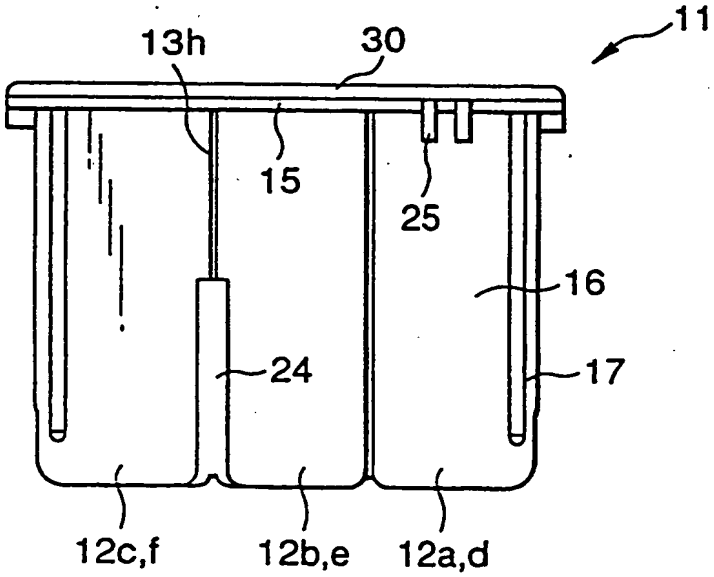

13h
30
11
15
25
16
24
17
12c,f
12b,e
12a,d

FIG.8(a)

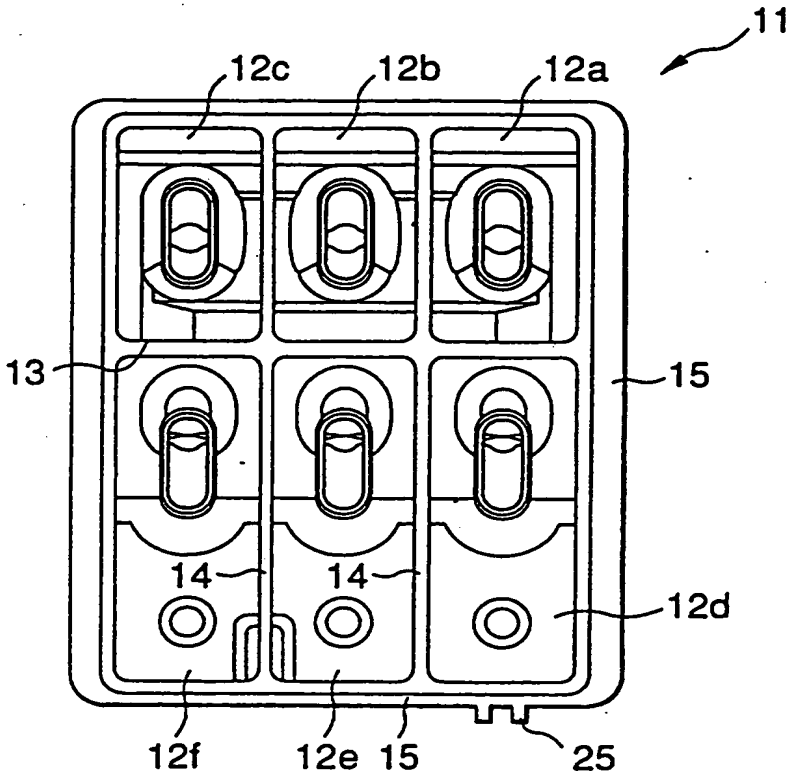

11
12c
12b
12a
13
15
14
14
12d
12f
12e
15
25

FIG.8(b)

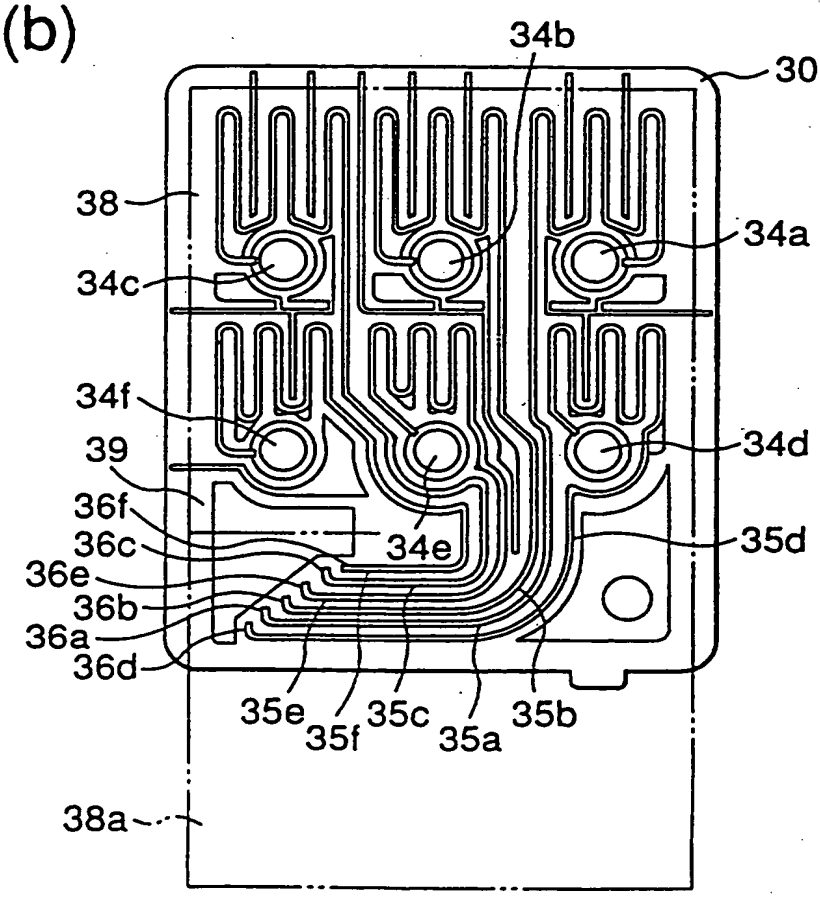

34b
30
38
34a
34c
34f
39
34d
36f
36c
34e
35d
36e
36b
36a
36d
35e
35f
35c
35a
35b
38a

FIG.9(a)

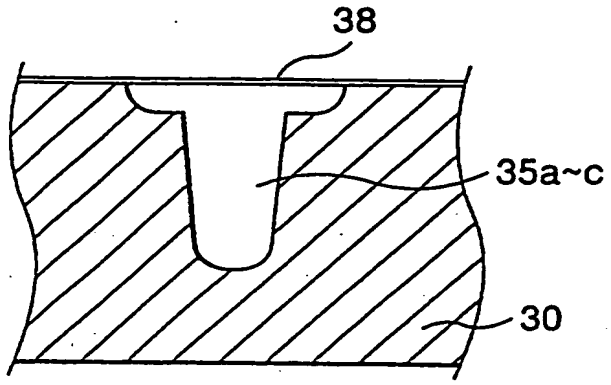


FIG.9(b)

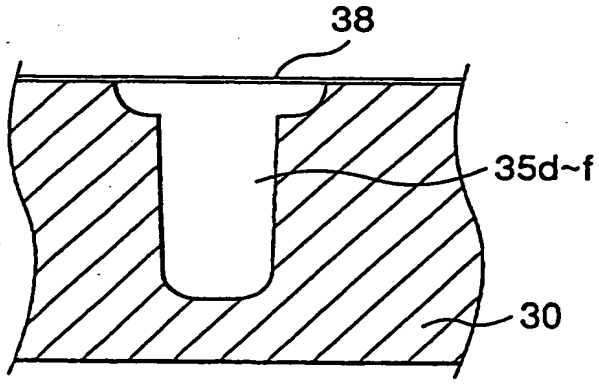


FIG.10(a)

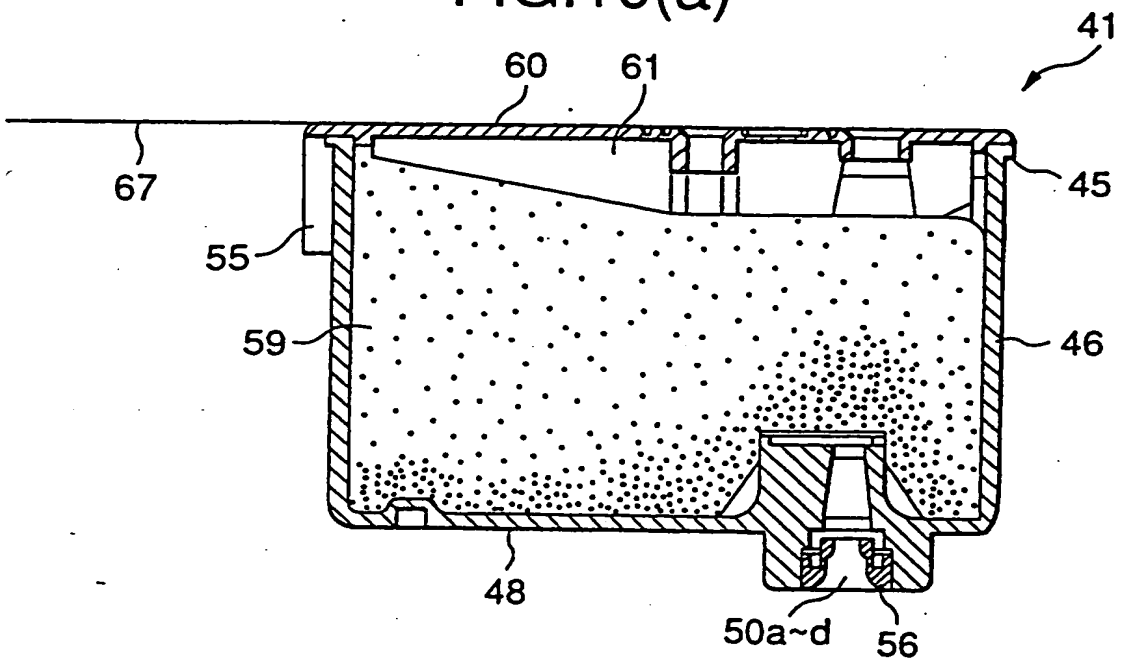


FIG.10(b)

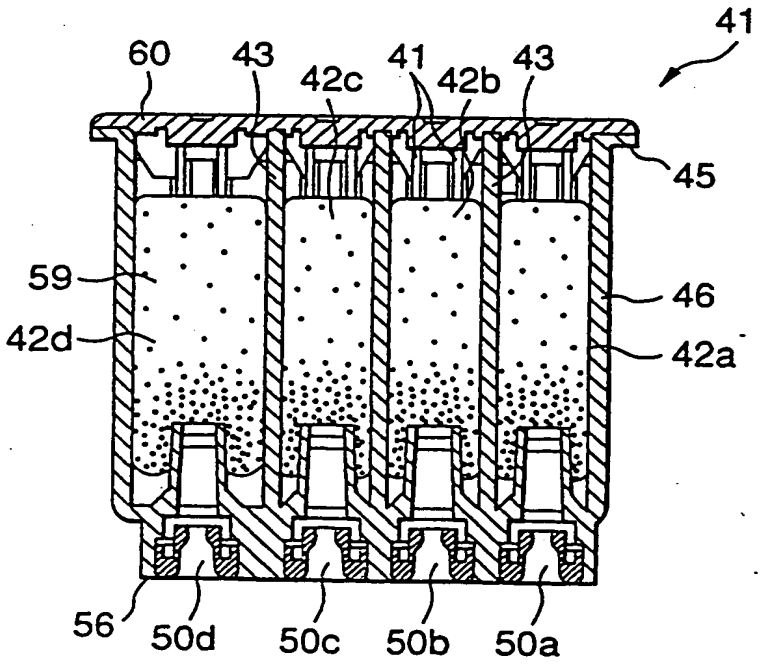


FIG.11(a)

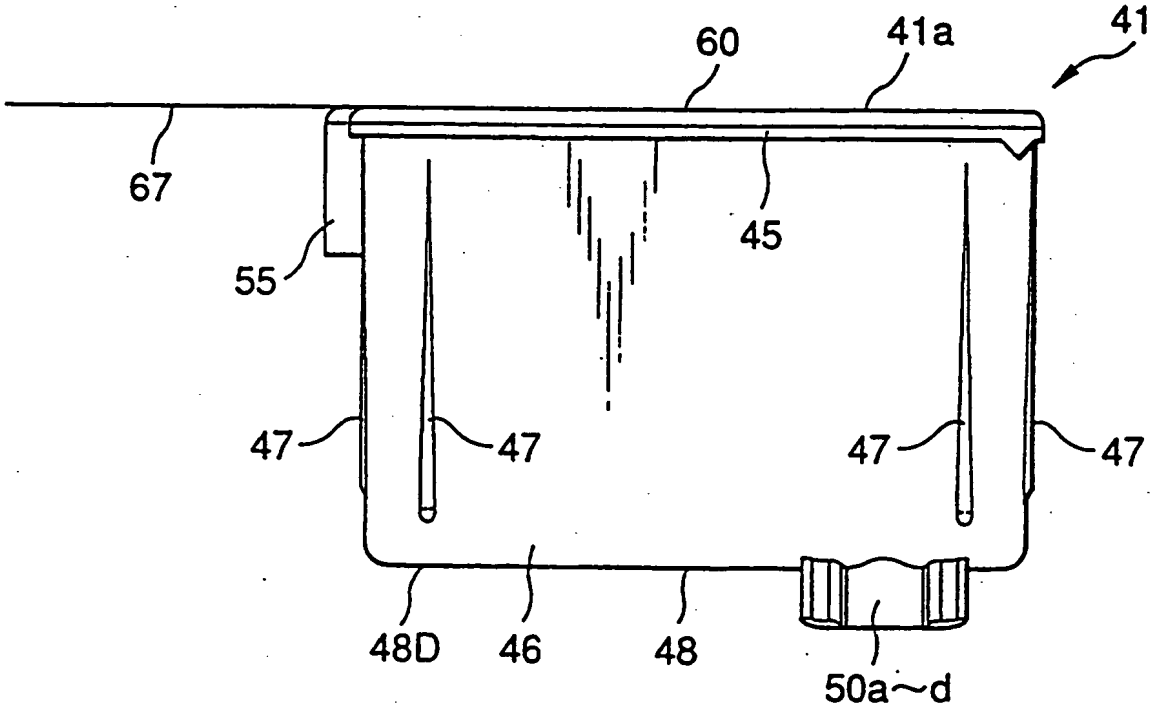


FIG.11(b)

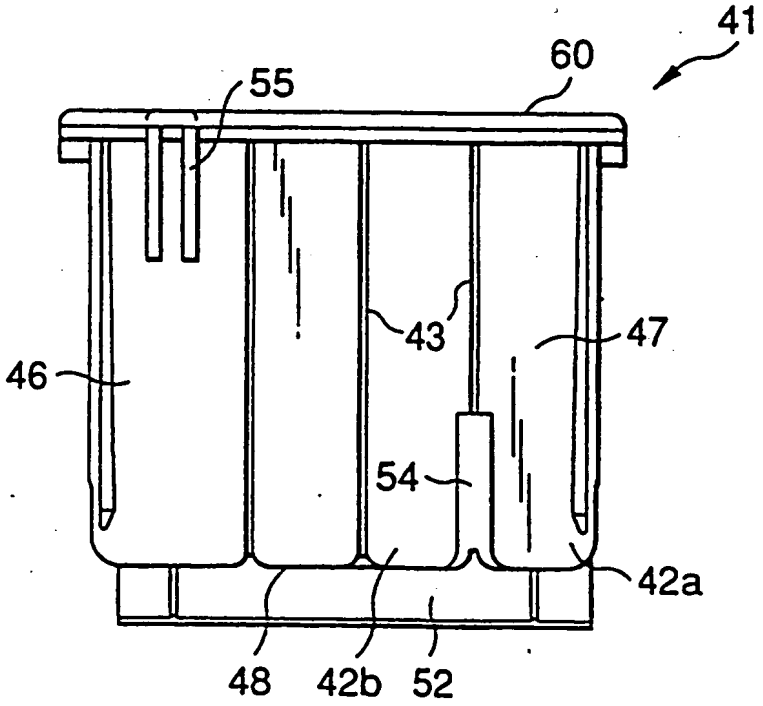


FIG.12(a)

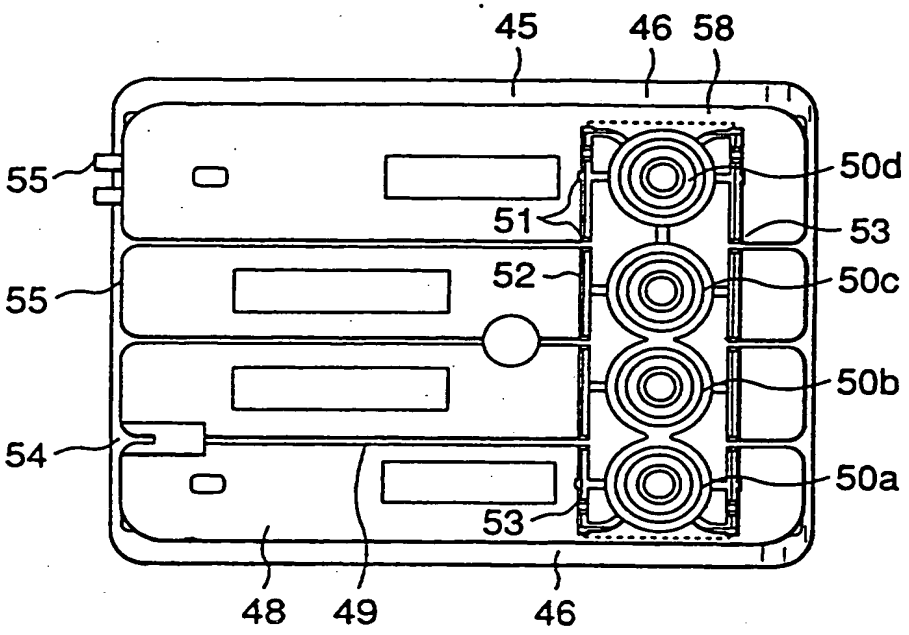
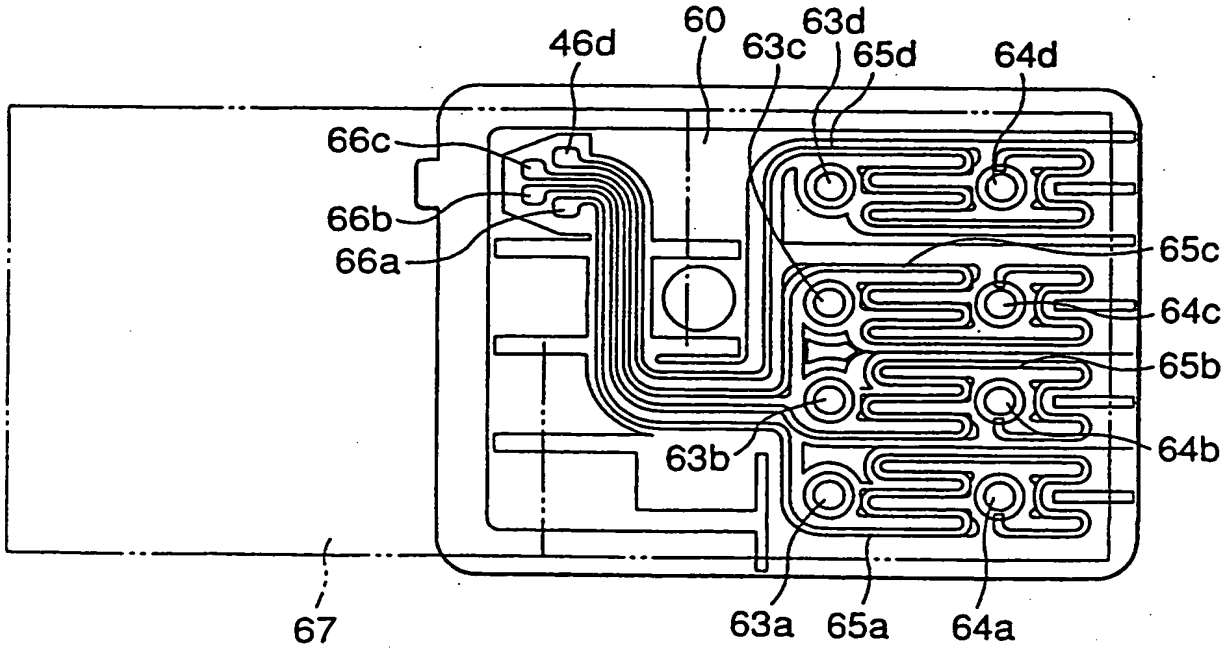


FIG.12(b)



INK CARTRIDGE

The invention relates generally to an ink cartridge and more particularly to an ink cartridge for use with a colour ink jet printer.

An ink cartridge including a plurality of ink chambers formed integrally with each other is utilised to conduct a printing operation in a colour printer. The colour printer typically uses inks of yellow, magenta, cyan and black. Such an ink cartridge is particularly used in a colour ink jet printer.

This type of ink cartridge, which uses inks of more than one colour, typically including yellow, magenta, cyan and black, frequently employs a multi-level density printing method. In cartridges utilising this multi-level density printing method, two types of ink of each colour, including one light and one deep colour, must be used. In designing an ink cartridge of a multi-level density printing type, if the ink chambers containing the inks are arranged in a line, there is a problem in that the size of the tank cannot be reduced beyond a certain point because of the size of the ink supply ports required for each ink chamber. Thus, each of the chambers cannot be reduced beyond a certain width. As a result, the ink cartridge is required to be constructed with extremely large length. Additionally, it is difficult to mount the ink cartridge on the carriage when it is so long. When loading such an ink cartridge, the ink cartridge may be shifted or skewed from its proper position, and in an extreme case, it is possible that the ink supply needles may be broken.

One way to increase the volumes of the ink chambers within the ink cartridge without increasing the overall size is to reduce the thickness of the partitioning walls between the ink chambers, for example. However, this approach may result in the problem of a reduced mechanical strength of the ink cartridge.

For any number of particular types of printer, the included carriages may uniform in size, as a result of the manufacturing requirements and parts management

requirements. Thus, the outside dimensions of various ink cartridges may be uniform. and thus it is possible that improper ink cartridges may be loaded onto a particular printer.

If the outside dimension of an ink cartridge is reduced, thus resulting in a reduction in the size of each the ink chambers, and an ink chamber has had a lot of ink used from it, or is an ink chamber having a small volume, even if a slight amount of ink evaporates from the ink chamber, the viscosity of the ink retained therein will change greatly, and thus will be different than the other inks.

Therefore, it would be beneficial to provide an ink cartridge for use with a colour ink jet printer which overcomes the problem of the prior art.

In a first aspect, this invention provides an ink cartridge for a printer; comprising

a plurality of ink chambers; and

a plurality of ink supply ports, an ink supply port being associated with each respective ink chamber, said ink supply ports being arranged in a plurality of linear arrays on one surface of said ink cartridge.

In a second aspect, this invention provides an ink cartridge for a printer, comprising:

a plurality of ink chambers, each of said ink chambers having a bottom surface; and

a plurality of ink supply ports, an ink supply port being associated with each respective ink chamber, each of said ink supply ports including an open end, said open end of each ink supply port being positioned flush with the bottom surface of the associated ink chamber.

In a third aspect, this invention provides an ink cartridge for a printer, comprising:

a plurality of ink chambers, a number of said ink chambers having a relatively smaller volume and a number of said ink chambers having a relatively larger volume;

a cover for sealing said ink cartridge; and

a plurality of circuitous air passages being formed integral with said cover, a circuitous air passage being associated with each respective ink chamber, each of said circuitous air passages placing each associated ink chamber in fluid communication with ambient air, each of said circuitous air passages being associated with an ink chamber having a relatively smaller volume having a larger resistance to fluid flow than each of said circuitous air passages associated with an ink chamber having a relatively larger volume.

In a fourth aspect, this invention provides an ink cartridge for a printer, comprising:

a plurality of side walls;

a plurality of ink chambers formed within said side walls and a bottom, each of said ink chambers having an open end;

a first reinforcing rib disposed around said ink cartridge adjacent the opened end thereof, said rib having a larger lengthwise dimension than widthwise dimension; and

a plurality of second reinforcing ribs positioned on said side walls of said ink cartridge, said second reinforcing ribs extending from said opening towards said bottom of said ink cartridge.

In a fifth aspect, this invention provides an ink cartridge for a printer, comprising:

a plurality of ink chambers;

at least one groove formed in said ink cartridge at a unique location on the outside of said ink chambers for each different type of ink cartridge, said at least one groove preventing the attachment of an improper ink cartridge, or an ink cartridge improperly, to a printer.

Generally speaking, in accordance with the invention an ink cartridge is provided with a plurality of ink supply ports communicating with a plurality of associated ink chambers. The chambers and ink supply ports are arrayed in a plurality

of linear arrays on one surface of the ink cartridge. The ink supply ports may be provided in a zig-zag or offset manner. With this novel and unique construction, the ink chambers may be reduced in size independent of the size of the ink supply ports.

In an ink cartridge including a plurality of small and large ink chambers, constructed in accordance with another aspect of the invention, air passages are formed in a cover member for covering the open end of the ink cartridge. The air passages communicate at first ends thereof with the plurality of large and small ink chambers and are placed in fluid communication with ambient air at the second ends thereof. The air passages communicating with the smaller of the plurality of ink chambers have a larger resistance to the flow of fluid than the air passages communicating with the larger of the plurality of ink chambers. With this novel and unique construction, the viscosities of inks in the various sized ink chambers may be kept uniform irrespective of the amount of ink contained in the chambers, thus compensating for evaporation and flow rates.

In an ink cartridge including a plurality of ink chambers, constructed in accordance with a further aspect of the invention, a reinforcing rib is formed on the ink cartridge. The lengthwise dimension of the reinforcing rib is formed larger than the widthwise dimension. A second reinforcing rib is also positioned protruding from each side wall of the ink cartridge while extending therealong. Thus, the required mechanical strength of the ink cartridge can be ensured, even if the thickness of the walls are reduced.

In an ink cartridge constructed in accordance with an additional aspect of the invention, at least one groove for preventing the incorrect mounting of the ink tank is formed in one of the side walls of ink cartridge. In each different type of ink cartridge the position of the groove is changed. Since each printer can be designed to accept an ink tank having only one particular groove, this unique construction eliminates the possibility of loading a wrong ink cartridge onto a printer.

Accordingly, it is an object of the invention is to provide a novel ink cartridge

which contains the proper amount of each colour ink in proportion to the amount of ink that is used in an ink cartridge having a standard exterior shape.

Another object of the invention is to provide a novel ink cartridge which is satisfactorily rigid without reducing the volumes of the ink chambers, and which cannot be improperly loaded onto a printer.

Yet another object of the invention is to provide a novel ink cartridge which can retain the uniformity of viscosities of inks contained therein.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the invention, reference is had, by way of example only, to the following description taken in connection with the accompanying diagrammatic drawings, in which:

Fig. 1(a) is a bottom plan view of an ink cartridge constructed in accordance with an embodiment of the invention;

Fig. 1(b) is a side elevation view of the ink cartridge constructed in accordance with the invention depicting the relationship of the ink cartridge to a printhead;

Fig. 2(a) is a bottom plan view showing the bottom of an ink cartridge constructed in accordance with an additional embodiment of the invention;

Fig. 2(b) is a bottom plan view showing the bottom of an ink cartridge constructed in accordance with an additional embodiment of the invention;

Fig. 3(a) is a bottom plan view showing the bottom of an ink cartridge constructed in accordance with an additional embodiment of the invention and depicts the relationship of the ink cartridge to ink supply needles;

Fig. 3(b) is a bottom plan view showing the bottom of an ink cartridge constructed in accordance with an additional embodiment of the invention;

Fig. 4(a) is a bottom plan view showing the bottom of an ink cartridge constructed in accordance with an additional embodiment of the invention and depicts the relationship of the ink cartridge to ink supply needles;

Fig. 4(b) is a bottom plan view showing the bottom of an ink cartridge constructed in accordance with an additional embodiment of the invention;

Fig. 4(c) is a bottom plan view showing the bottom of an ink cartridge constructed in accordance with an additional embodiment of the invention;

Fig. 5(a) is a cross-sectional view of an ink cartridge constructed in accordance with an additional embodiment of the invention;

Fig. 5(b) is a cross-sectional view of the ink cartridge of Fig. 5(a);

Fig. 6(a) is a cross sectional view of a comer of the ink cartridge shown in Fig. 5(a);

Fig. 6(b) is a cross sectional view of a comer of the ink cartridge shown in Fig. 5(a);

Fig. 7(a) is a side elevational view of the ink cartridge as shown in Fig. 5(a);

Fig. 7(b) is a side elevational view of the ink cartridge as shown in Fig. 5(a);

Fig. 8(a) is a bottom plan view of the ink cartridge shown in Fig. 5(a);

Fig. 8(b) is a top plan view of the cover of the ink cartridge shown in Fig. 5(a);

Fig. 9(a) is a cross-sectional view of a cover groove constructed in accordance with the invention;

Fig. 9(b) is a cross-sectional view of a second cover groove constructed in accordance with the invention;

Fig. 10(a) is a cross-sectional view of an ink cartridge constructed in accordance with another embodiment of the invention;

Fig. 10(b) is a cross-sectional view of the ink cartridge of Fig. 10(a);

Fig. 11(a) is a side elevational view of the ink cartridge shown in Fig. 10(a);

Fig. 11(b) is a side elevational view of the ink cartridge shown in Fig. 10(a);

Fig. 12(a) is a bottom plan view of the ink cartridge shown in Fig. 10(a); and

Fig. 12(b) is a top plan view of the cover of the ink [illegible] Fig. 10(a).

The preferred embodiments of the present invention will be described with reference to the accompanying drawings.

Figs. 1(a) and 1(b) depict an ink cartridge constructed in accordance with an embodiment of the invention in which the ink cartridge is used in an ink jet printing device of the multi-level density printing type. An ink cartridge body, indicated generally as 1, includes ink chambers 2a-2e for containing inks of magenta, cyan and yellow, and inks of light magenta and cyan, and an ink chamber 2f having a larger capacity than the capacity of ink chambers 2a-2e for containing black ink. These ink chambers are partitioned by partitioning walls 3h within ink cartridge body 1.

Associated ink supply ports 4a to 4f are formed in a bottom surface of ink cartridge body 1 and communicate with respective ink chambers 2a to 2f. Ink supply ports 4a-4f are disposed closer to one side of ink cartridge body 1. Ink supply ports 4a to 4f are arranged in a zig-zag or off-set fashion, as is shown in Fig. 1. Because of the zig-zag or offset arrangement of ink supply ports 4a-4f, neither ink chambers 2a-2f nor ink supply ports 4a-4f interfere with each other when ink chambers 2a to 2f are formed as thin as possible, so that chambers 2a-2f may be made thinner than the diameter of each of ink supply ports 4a-4f.

As shown in Fig. 1(b) ink cartridge body 1 is adapted to be mounted on a printhead p, and an ink supply needle q is injected into each ink supply port 4a to 4f. Then, ink from each of ink chambers 2a to 2f are supplied to associated nozzles t of a nozzle plate 5 by way of associated ink passages r.

In this embodiment, ink chambers 2a to 2d may be formed with a width being as thin as possible irrespective of the outside diameters of ink supply ports 4a to 4d. Therefore, the width of ink cartridge body 1 may be reduced in size corresponding to the cumulative reduction to the thickness of these chambers.

Figs. 2(a) and 2(b) depict ink cartridges 200a and 200b using inks of four

colour inks, which in a preferred embodiment include cyan, magenta, yellow and black, which are adapted for use in a full colour printer. As in ink cartridge 1, ink cartridge 200a includes a plurality of chambers 202aa-202ad communicating with offset supply ports 204aa-204ad respectively. In ink cartridge 200b shown in Fig. 2(b), ink chamber 202bd containing black ink is formed separately from the other chambers. As in the cartridge of the first embodiment, the ink supply ports 204ba-204bc of ink cartridge 200b are arranged in a zig-zag, off-set fashion. Therefore, the overall size of ink cartridges 200a or 200b may be reduced without any reduction required in the outside diameters of ink supply ports 204aa-204ad or 204ba-204bc.

Figs. 3(a) and 3(b) depict another embodiment of ink cartridges used in an ink jet printing device of the multi-level density printing type constructed in accordance with the invention and generally indicated as 300a, 300b.

Ink cartridge body 300a shown in Fig. 3(a) is provided with a total of eight ink chambers 302aa-302ah which in a preferred embodiment contain inks of four colours, cyan, magenta, yellow and black, both light and deep versions for a total of eight different inks. Ink chambers 302aa to 302ah are arranged such that they are partitioned at least in part by one long partitioning wall 303av, which forms one wall of each ink chamber, and a plurality of short partitioning walls 303ah intersection wall 303av to form individual chambers 302aa-302ah. These ink chambers 302aa-302ah are arranged such that four chambers are arranged on one side of long partitioning wall 303av, and the remaining four chambers are arranged on the other side thereof. Ink supply ports 304aa-304ah, which communicate with the ink chambers 302aa to 302ah respectively, are provided in a central portion on the bottom of cartridge body 300a. Four ink supply ports 304aa-304ad are arranged on one side and along long partitioning wall 303av, corresponding to a linear array of ink supply needles q, while the remaining four ink supply ports 304ae-304ag are arranged on the other side and along long partitioning wall 303av, corresponding to another linear array of needles q. Since ink chambers 302aa to 302ah are thus divided into two groups, the size of ink cartridge body 300a

can be reduced without substantially changing the size of the ink chambers 302aa-302ah. Further, the ink cartridge may be loaded to the printhead with less of a likelihood of inclination of the cartridge and improper loading, thus ensuring easy and reliable loading of the cartridge.

In the above embodiment, the volumes of the ink chambers 302aa-302ah are equal to one another. In the embodiment shown in Fig. 3(b), the ink chambers may be arranged depending on the amount of ink in a particular ink chamber that will be used for a particular use, such that ink chambers of large and small volumes are separately disposed within an ink cartridge 300b. For example, as shown in Fig. 3(b), ink chambers having larger volumes are disposed beyond long partition wall 303bv which does not extend entirely along ink cartridge 300b and those having smaller volumes are disposed along wall 303bv. In the case of Fig. 3(b), ink chambers 302ba-302bd contain ink of light and deep cyan and magenta are separately disposed on the first and second sides of long partitioning wall 303bv. Ink chambers 302be and 302bf, which contain inks of yellow and black and which are used a lot, unlike ink chambers 302ba-302bd, are disposed beyond wall 303bv and are not divided thereby. Ink supply ports 304be and 304bf corresponding to ink chambers 302be and 302bf, are linearly arranged in alignment with ink supply ports 304ba and 304bc.

Additional embodiments constructed in accordance with the invention separately are shown in Figs. 4(a)-4(c) respectively. In the embodiment depicted in Fig. 4(a), eight ink chambers 402aa-402ah, respectively, are arranged in two linear arrays; one is located adjacent a first side of the bottom of an ink cartridge 400a and the other is located adjacent a second side thereof. In ink cartridge 400a, the linear arrays of ink supply ports 404aa-404ah are aligned with linear arrays of ink supplying needles 400aq, respectively, and are positioned adjacent first and second sides 405aa and 405ab of ink tank 400a. In ink cartridge 400a, the volumes of the ink chambers 402aa-402ah may be varied in accordance with the amount of ink required depending on the kind of image to be printed by a printer employing the cartridge. Thus, an image requiring control of the

granularity in highlight, for example, a landscape, a portrait and photograph, or alternatively an image mainly containing graphs and text, or the like, may be accommodated by merely horizontally shifting partitioning walls 403av between the appropriate ink chambers 402aa-402ah. In other words, partitioning walls 403av need not be linearly aligned to form a single long wall as in ink cartridge 300a or 300b.

In ink cartridge 400b of Fig. 4(b), eight chambers are also provided with the ink supply ports being arranged on only the sides of the bottom, the primary difference being the use of a single wall 403 along the length of the ink cartridge to form the chambers. Ink supply ports 404ba-404bh are arranged in two linear arrays located adjacent first and second sides 405ba and 405bb of the bottom of the ink cartridge 400b, as in ink cartridge 400a. In ink cartridge 400b, a single partitioning wall 403bv divides the ink chambers at a position closer to side 405bb of the bottom of ink cartridge 400b into two groups of ink chambers. The first group including ink chambers 404ba-404bd having larger volumes, and the second group including ink chambers 404be-404bh having smaller volumes.

In ink chamber 400c shown in Fig. 4(c), only six chambers are formed to accommodate larger chambers is provided. Ink supply ports 404ca-404cf are also positioned in two linear arrays located adjacent first and second sides 405ca and 405cb of the bottom of ink cartridge 400c. In this case, the linear array adjacent side 405ca consists of ink supply ports 404ca, 404cb, 404ce and 404cf, and the linear array adjacent side 405cb consists of only two ink supply ports 404cc and 404cd. Ink chambers 402ce and 402cf, which in a preferred embodiment contain inks of yellow and black, are disposed beyond a partitioning wall 403cv and are not partitioned by the partitioning wall 403cv, so that these chambers have larger volumes.

In the ink cartridges thus far described, ink supply ports are disposed in two linear arrays. The number of the linear arrays of ink supply ports utilised may be three or larger if the configuration and size of the ink cartridge require an increase of the

number of arrays. Additionally, in each of the embodiments, it is possible to provide the ink supply ports in a zig-zag, off-set arrangement, as shown in Fig. 2(a), to further conserve space and allow the ink chambers to be even thinner.

The embodiments constructed in accordance with the cartridges illustrated in Figs. 5(a)-7(b) are constructed such that a plurality of ink chambers of the largest possible total volumes are formed in a fixed inner space of an ink cartridge without decreasing the strength of the ink cartridge and, while insuring that the viscosities of the inks remain uniform.

An ink cartridge body, indicated generally as 11 and constructed in accordance with an additional embodiment of the invention, is shown in Figs. 5(a)-7(b). Ink cartridge body 11 is formed of polypropylene in a preferred embodiment, which is low in permeability to vapour but is relatively weak in strength. Ink cartridge body 11 takes the form of a cuboid so as to contain the greatest amount of ink possible. The inner space of ink cartridge 11 is partitioned by one vertical partitioning wall 13v, and two horizontal partitioning walls 13ha and 13hb to form six ink chambers 12a to 12f arrayed in a matrix of three columns and two rows. Ink chambers 12a to 12c, which have a smaller volume (referred to as smaller ink chambers) in a preferred embodiment contain inks of deep magenta and cyan, and black ink, while ink chambers 12d to 12f, which have a larger volume (referred to as large ink chambers), in a preferred embodiment contains inks of light magenta and cyan, and ink of yellow for producing a halftone.

A reinforcing rib 15 extends outwardly from the peripheral edge of a top open end 11a of ink cartridge body 11. The lengthwise dimension of rib 15 is larger than the widthwise dimension thereof. A second rib 17 for receiving a sensor and preventing a deformation of ink cartridge body 11 protrudes from each side wall 16 of ink cartridge body 11 and is formed as an elongated member along each side wall 16. As shown in Figs. 6(a) and 6(b), each corner 16a connecting adjacent side walls of the cartridge body 11 is designed such that the thickness of the corner is uniform over the range

from open end 11a (Fig. 6(a)) of the cartridge body to bottom 180 (Fig. 6(b)), and the inside and outside radii r and R are gradually reduced from open end 11a of cartridge body 11 to the bottom 180.

Bottom surfaces 18 of these chambers 12a to 12f are formed flush with the bottom surface 180 of in cartridge body 11 so as to allow for the greatest volumes of the ink chambers. Positioning grooves 19a and 19b, which are respectively provided adjacent the group of smaller ink chambers 12a to 12c and the group of larger ink chambers 12d to 12f, are formed in the bottom surfaces 18 of ink chambers 12a-12f. Within positioning grooves 19a and 19b, tubularly shaped ink supply ports 20a-20f, are positioned so as to be formed continuous to and flush with the bottoms 18a-18f of the ink chambers 12a to 12f. The openings of ink supply ports 20a and 20f are closed with tapes 22a-22f.

As is farther shown in Fig. 7(b), a groove 24 is provided for preventing the cartridge from being improperly attached to a printhead. Groove 24 is formed in one of the lengthwise side walls and extends parallel with, and along a partitioning wall 13h, defining the adjacent ink chambers 12e and 12f by way of example. A raised portion 25 is formed on the upper portion of the side wall 16 to further prevent improper attachment of the ink cartridge to a printhead. The carriage (not shown) is provided with an engaging protrusion. When attaching cartridge 11 to the printhead, the engaging protrusion of the carriage is coupled the groove 24 of the cartridge to ensure correct attachment of cartridge 11 to the printhead.

In the present embodiment, groove 24 is formed along horizontal partitioning wall 13h between ink chamber 12e and ink chamber 12f. The position of the groove 24 may be changed for each different type ink cartridge, or a plurality of grooves 24 may be used. In this case, proper combinations of the groove position and the number of grooves may be used for identifying different types of ink cartridges, whereby erroneous attachments of improper ink cartridges in a printer are prevented. Raised portion 25 provided in the upper portion of the side wall 16 may also be positioned

slightly differently to further identify particular types of ink cartridges, and aid in preventing the use of an incorrect ink cartridge in a printer.

In Fig. 7(a) in addition to Figs. 5(a) and 5(b), a cover member 30 is provided for closing open end 11a of cartridge body 11. Cover member 30 has the same planar shape as the outer edge of reinforcing rib 15 provided on open end 11a of the cartridge body 11. Vertical ribs 31 are provided on the inner surface of cover member 30 and in each ink chamber for pressing porous members 29 contained in each of ink chambers 12a to 12f. Each vertical rib 31 extends further into the associated ink chamber adjacent associated ink supply ports 20a-20f than in the other portions of the associated ink chamber. Vertical ribs 31 cooperate with ink supply ports 20a-20f to highly compress porous members 29 therebetween. As a result, the size of the pores in porous members are reduced, to generate a strong capillary action in the vicinity of this compression. By this strong generated capillary action, ink which is uniformly absorbed in porous member 29 can be directed to the associated ink supply ports 20a-20f as the amount of ink remaining in the ink chamber decreases.

As shown in Fig. 8(b), through-holes 34a to 34f for ink filling and air venting are formed in cover member 30 covering open end 11a of ink cartridge body 11. One through-hole 34a-34f is associated with a respective one of ink chambers 12a to 12d. Circuitous grooves 35a-35f are formed on the inner surface of cover member 30 coupling through-holes 34a to 34f to a plurality of exit through-holes 36a to 36f. Circuitous grooves 35a to 35c which communicate with smaller ink chambers 12a to 12c, are much longer than circuitous grooves 35d to 35f, which communicate with larger ink chambers 12d to 12f. By so selecting the length of the circuitous grooves, when ink chambers 12a to 12f are opened to the air by stripping off a film 38, the amount of ink evaporated from small ink chambers 12a to 12c will be small as compared to the amount of ink evaporated from large ink chambers 12d to 12f.

As shown in Figs. 9(a) and 9(b), each of circuitous grooves 35a to 35c communicating with smaller ink chambers 12a to 12c has a smaller cross-sectional area

than that of each of circuitous grooves 35d to 35f communicating with larger ink chambers 12d to 12f, whereby resistance to fluid flow in circuitous grooves 35a to 35c is greater than the resistance in circuitous grooves 35d-35f.

Exit through-holes 36a to 36f at which circuitous grooves 35a-35f terminate are arrayed so as to form an angled array of exit through-holes, the vertex of which is located at the front of the array when viewed in the direction of stripping the film. Thus, a portion 38a of film 38 can easily be stripped from the cartridge. Film 38 for sealingly covering circuitous grooves 35 is formed such that one edge of film 38 is equal to the width of cover member 30, and the other edge thereof is longer than the length of cover member 30. Therefore, film 38 may readily be formed by merely cutting a strip from a reel of material of the appropriate width. One side of film 38 is cut out to form a cutout 39 defining portion 38a so as to allow exit through-holes 36a-36f to be exposed to ambient air when portion 38a of film 38 at cutout 39 is removed.

In a preferred embodiment, ink cartridge body 11 is constructed of polypropylene which has a low permeability to vapour, but which is flexible and weak in strength. However, cartridge body 11 is substantially uniformly reinforced in both the lengthwise and widthwise directions by reinforcing rib 15, which is positioned on the peripheral edge of open end 11a of ink cartridge 11 and is shaped such that the lengthwise dimension of rib 15 is larger than the widthwise dimension thereof. Ink cartridge body 11 is reinforced also in the vertical direction by a plurality of ribs 17, which are provided vertically along each side wall 16. The inside and outside radii r and R are gradually reduced from open end 11a of cartridge body 11 to bottom 180 thereof. Therefore, the ink chambers may be formed with a width as thin as possible, thereby increasing the volumes of the ink chambers. With the low vapour permeability of the polypropylene, inks can maintain their quality for an extended period of time.

Groove 24 for avoiding improper mounting of an ink tank is provided on side wall 16 of ink cartridge body 11 so that it extends to the bottom surface 180 of ink chamber 11 and extends along the partitioning wall 13h. Groove 24 cooperates with an

engaging protrusion formed on the carriage to prevent ink cartridge 11 from being attached to an incorrect printhead, or to prevent ink cartridge 11 from being improperly attached to the correct printhead, thus to secure a stable mounting of the ink cartridge on the carriage.

The technique implemented in the embodiments shown in Figs. 5 through 9 include reinforcement of ink cartridge 11 of the type in which the ink chambers 12a to 12f are arranged in two arrays, and the viscosities of the various inks are maintained constant. It is evident that the technique is also applicable to the ink cartridge of the single array type shown in Fig. 1.

Embodiments shown in Figs. 10 to 12 include techniques applied to ink cartridges of the single array type.

As is shown in Figs. 10-12, an ink cartridge indicated generally as 41, is formed with ink chambers 42a to 42c, which in a preferred embodiment contain inks of magenta, cyan and yellow, and an ink chamber 42d, wider than ink chambers 42a-42c, which in a preferred embodiment contains black ink. Ink chambers 42a-42d are partitioned from each other by a plurality of partitioning walls 43.

A reinforcing rib 45 extends outwardly from the peripheral edge of open end 41a of ink cartridge body 41. The lengthwise dimension of rib 45 is larger than the widthwise dimension thereof so that rib 45 is as strong in the lengthwise direction as it is in the widthwise direction. As shown in Figs. 11(a) and 11(b), a rib 47 for receiving a sensor and preventing a deformation of ink cartridge body 41 protrudes from each of the side walls 46 of ink cartridge body 41 while extending vertically along the side wall in Figs. 11(a) and 11(b). Each corner connecting the adjacent side walls of the cartridge body is designed such that the thickness of the material forming the corner is uniform over the range from open end 41a of ink cartridge body 41 to bottom 480, and the inside and outside radii r and R are gradually reduced from open end 41a of ink cartridge body 41 to bottom 480 as in Figs. 6(a) and 6(b) of the prior embodiment.

A groove 54 for preventing an incorrect ink cartridge from being attached to a

printhead, or for preventing an ink cartridge from being incorrectly mounted to a printhead is formed in one of lengthwise side walls 46, while extending from bottom surface 480 of ink cartridge 41 and extending parallel to partitioning walls 43. An additional raised portion 55 for preventing improper ink tank mounting is formed in the upper portion of side wall 46. The carriage (not shown) is provided with an engaging protrusion formed therein for engaging raised portion 55. When attaching the cartridge to the printhead the protrusion of the carriage is fit to raised portion 55 of ink cartridge 41, to ensure the correct attachment of ink cartridge 41 to the printhead.

Bottom surfaces 480 of ink chambers 42a to 42c are demarcated with grooves 49 extending parallel to the associated partitioning walls 43. Tubular ink supply ports 50a to 50d are coupled with one another and project from bottom surfaces 48 in a linear arrangement. Frames 52 are positioned on opposing sides of ink supply ports 50a to 50d along the lengthwise edge of the linear arrangement thereof. Ink supply ports 50a to 50d are fixed to frames 52 by ribs 51.

Frames 52 extend away from bottom surfaces 48 a distance slightly greater than the extension of each of ink supply ports 51a and 50d away from bottom surfaces 48 and are located at either end of the ink supply port linear arrangement. A sheet of tape 58 or the like is applied over the linear arrangement of ink supply ports 50a to 50d and frames 52, whereby these ink supply ports are sealed. Tape 58 is then cut at a position along each of frames 52. Cutouts 53 for air escape are formed at the ridges of the frames 52, allowing for the passage of air and ensuring reliable adhesion of tape 58.

As is shown in Figs. 10a and 10b, rubber sealing rings 56 are provided to be fit within ink supply ports 50a to 50d. When ink supply needles formed of plastic or other appropriate material, which communicate with the printhead, are injected into ink supply ports 50a to 50d, the ink supply needles and the ink supply ports are coupled and sealed in an air-tight manner as a result of rubber sealing rings 56.

A cover member 60 is provided for sealing open end 41a ink cartridge body 41. As shown in Figs. 10(a) and 10(b), ribs 61 are provided on the inner surface of cover

member 60 for each of ink chambers 42a to 42c and extend in a direction from the interior of each ink chamber 42a to 42c away from cover member 60. Ribs 61 exert a force on each porous member 59 contained in each ink chamber 42a-42d and aid in compressing each porous member 59.

As is shown in Fig. 12(b), ink filling through-holes 63(a)-63(d) and air escape through-holes 64(a)-64(d) are formed in a central portion of cover member 61 at a position toward the side of each ink chamber 42a-42d including ink supply ports 50a-50d of cover member 60. Circuitous grooves 65(a)-65(d) are formed in the upper surface of cover member 60 and extend from the associated air escape through-holes 64(a)-64(d) to exit through-holes 66a to 66d formed in another portion of the upper surface of cover member 60. Circuitous grooves 65(a)-65(d) are provided corresponding to each of ink chambers 42a to 42d. During use, the portion 67a of a film 67 covering exit through holes 66a-66d is stripped off, exposing ink chambers 42a to 42d to ambient air through the associated circuitous groove 65(a)-65(d). The portion of film 67 not removed forms circuitous grooves 65(a)-65(d) into air passages. The large resistance to fluid flow of each of circuitous grooves 65(a)-65(d) greatly impedes the evaporation of ink from the ink chambers.

Exit through-holes 66a to 66d at which circuitous grooves 65(a)-65(d) terminate are gathered at a location and arrangement to form an array of the through-holes in which the most extended through-holes 66b and 66c of those through-holes are located at the front of the array when viewed in the direction of stripping film 67a. Film 67a can easily be stripped off by pulling a portion of the film located at the front of the array.

As seen from the foregoing description, a plurality of ink chambers may be arranged in one or more linear arrays of one surface of an ink cartridge. Therefore, if ink supply ports communicating with the ink chambers are arrayed in a zig-zag or off-set fashion, or the ink chambers, together with ink supply ports, are positioned on opposed sides of the ink chambers, the width of the ink chambers may be reduced

independently, and to a size less than of the outside diameters of the ink supplying ports. Thus, ink cartridge of this type used in connection with a full colour ink jet printer may be reduced to as small a size as possible. In accordance with the invention, the ink supply ports are formed recessed within the bottom surfaces of the ink chambers so as to be substantially flush with the bottom surfaces of the ink supply ports. Therefore, if the shapes of the ink cartridges are substantially the same, the volumes of the ink chambers may be increased to as great an extent as possible. Thus, the frequency of replacing cartridge is reduced, and a more economical ink cartridge is provided.

In accordance with the invention, the air passages communicating with smaller ink chambers housing less ink are longer than air passages communicating with larger ink chambers housing more ink. Thus, the evaporation of ink within the smaller ink chambers which can greatly affect the viscosity of the ink contained therein, is minimised, ensuring stable printing for an extended period of time.

Also in accordance with the invention, a reinforcing rib which has a lengthwise dimension larger a widthwise dimension, is positioned around the opening at the open end of the ink cartridge. Further, another reinforcing rib protrudes from each side wall of the ink cartridge, and extends along the side wall from the open end to the bottom of the ink tank. Thus, even if the ink cartridge is formed as thin as possible using a soft material, so as to be able to contain the largest possible amounts of each of the inks, the ink cartridge has a rigidity high enough to withstand vibrations and variations of acceleration caused during the transportation and movement of the cartridge. Further, the provision of a different groove arrangement for preventing the improper attachment of an ink cartridge. Even if the shapes of all types of ink cartridges are substantially the same irrespective of the type of the printer, only the ink cartridge with the proper groove arrangement can be loaded correctly by engaging the groove arrangement with a counter protrusion arrangement provided on the carriage. The groove may be provided extending along a side wall of the ink tank. Therefore, a continuous, uniform supply of

carriages in a printer.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above constructions without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

The aforegoing description has been given by way of example only and it will be appreciated by a person skilled in the art that modifications can be made without departing from the scope of the present invention.

CLAIMS

1. An ink cartridge for a printer; comprising

a plurality of ink chambers; and

a plurality of ink supply ports, an ink supply port being associated with each respective ink chamber, said ink supply ports being arranged in a plurality of linear arrays on

one surface of said ink cartridge.

2. The ink cartridge of claim 1, wherein said ink supply ports in each of said linear arrays of said ink supply ports are arrayed in a zig-zag, offset pattern on one surface of the ink cartridge.

3. The ink cartridge of claim 1, wherein said ink supply ports are arranged in a plurality of linear arrays on a central portion of said one surface of said ink cartridge.

4. The ink cartridge of any preceding claim, wherein said ink supply ports are arranged adjacent side edges of one surface of said ink cartridge.

5. An ink cartridge for a printer, comprising:

a plurality of ink chambers, each of said ink chambers having a bottom surface; and

a plurality of ink supply ports, an ink supply port being associated with each respective ink chamber, each of said ink supply ports including an open end, said open end of each ink supply port being positioned flush with the bottom surface of the associated ink chamber.

6. An ink cartridge for a printer, comprising:

a plurality of ink chambers, a number of said ink chambers having a relatively smaller volume and a number of said ink chambers having a relatively larger volume;

a cover for sealing said ink cartridge; and

a plurality of circuitous air passages being formed integral with said cover, a circuitous air passage being associated with each respective ink chamber, each of said circuitous air passages placing each associated ink chamber in fluid communication with ambient air, each of said circuitous air passages being associated with an ink chamber having a relatively smaller volume having a larger resistance to fluid flow than each of said circuitous air passages associated with an ink chamber having a relatively larger volume.

7. The ink cartridge of claim 6, wherein each of said air passages associated with an ink chamber having a relatively smaller volume is longer than each of said air passages associated with an ink chamber having a relatively larger volume.

8. The ink cartridge of claim 6 or claim 7, wherein each of said air passages associated with an ink chamber having a relatively smaller volume has a smaller cross-sectional area than each of said air passages associated with an ink chamber having a relatively larger volume.

9 The ink cartridge of any one of claims 6 to 8, wherein each of said air passages are further formed of circuitous grooves formed in said cover member and a sealing member covering said surface of said cover member and said circuitous grooves.

10. The ink cartridge of claim 9, wherein said sealing member is formed of a long film having a first portion covering all but an end portion of each of said circuitous grooves, and a second portion which is removed during use to place at least an end of

each of said circuitous grooves in fluid communication with ambient air.

11. An ink cartridge for a printer, comprising:

a plurality of side walls;

a plurality of ink chambers formed within said side walls and a bottom, each of said ink chambers having an open end;

a first reinforcing rib disposed around said ink cartridge adjacent the opened end thereof, said rib having a larger lengthwise dimension than widthwise dimension; and

a plurality of second reinforcing ribs positioned on said side walls of said ink cartridge, said second reinforcing ribs extending from said opening towards said bottom of said ink cartridge.

12. The ink cartridge of claim 11, wherein said side walls connect at a corner, each corner connecting adjacent side walls of said ink cartridge is shaped such that the inside and outside radii are gradually reduced from said open end of said ink cartridge to said bottom thereof.

13. An ink cartridge for a printer, comprising:

a plurality of ink chambers;

at least one groove formed in said ink cartridge at a unique location on the outside of said ink chambers for each different type of ink cartridge, said at least one groove preventing the attachment of an improper ink cartridge, or an ink cartridge improperly, to a printer.

14. The ink cartridge of claim 13, wherein at least one unique raised portion is provided on the outside of said ink cartridge for preventing the attachment of an improper, ink cartridge, or an ink cartridge improperly to a printer.

15. An ink cartridge for a printer substantially as shown in or as described with reference to any one of the accompanying figures.

The Patent Office

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Claims searched: 1-4

Examiner: Gary Williams
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Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B6F: FLR

Int Cl (Ed.6): B41J: 2/175

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	NONE	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.